Claims:

1. A multi-descriptive encoder for generating a plurality of multi-descriptive bit streams from a single source signal, the encoder comprising:

a source signal input port for supplying the source signal;

a first coder applied to the source signal input port, the first coder for generating a first multi-descriptive bit stream from the source signal, the first coder employing a first coding algorithm which includes a first quantization process in which a first data value based on the source signal is coded with use of a corresponding first quantized data value, thereby resulting in a corresponding first quantization error representative of a difference between said first data value and said first quantized data value; and

a second coder applied to the source signal input port, the second coder for generating a second multi-descriptive bit stream from the source signal, the second coder employing a second coding algorithm which includes a second quantization process in which a second data value, based on the source signal and corresponding to said first data value, is coded with use of a corresponding second quantized data value, thereby resulting in a corresponding second quantization error representative of a difference between said second data value and said second quantized data value,

wherein said second quantized data value as produced by said second quantization process is based at least in part on said first quantization error resulting from said first quantization process.

2. The encoder of claim 1 wherein said first coding algorithm and said second coding algorithm differ in at most the corresponding quantization processes included therein.

3. The encoder of claim 1 wherein said source signal comprises a speech signal.

4. The encoder of claim 1 wherein said second quantized data value as produced by said second quantization process is determined so that said second quantization error

resulting from said second quantization process is such that if combined with said first quantization error resulting from said first quantization process to produce a net quantization error, said net quantization error will be less than said first quantization error.

5. The encoder of claim 1 wherein said first quantization process and said second quantization process each select said corresponding quantized data values from a single predetermined set of quantization values.

6. The encoder of claim 5 wherein said first and second quantization processes each comprise a pulse code modulation scheme which selects said corresponding quantized data values from a single predetermined set of scalar quantization values, wherein said first data value based on the source signal and said second data value based on the source signal are equal to a common scalar value representative of a portion of said source signal, wherein said first quantized data value is selected from said set of scalar quantization values as an approximation to said common scalar value, and wherein said second quantized data value is selected as a neighboring value in said set of quantization values to said first quantized data value when said common scalar value is closer to an average of said first quantized data value and said neighboring value than to any value in said set of quantization values.

7. The encoder of claim 5 wherein said first and second quantization processes each comprise a pulse code modulation scheme which selects said corresponding quantized data values from a single predetermined set of scalar quantization values, wherein said first data value based on the source signal is equal to a scalar value representative of a portion of said source signal and said second data value based on the source signal is equal to said first data value offset by a fixed predetermined amount, and wherein said first quantized data value is selected from said set of scalar quantization values as an approximation to said first data value and said second quantized data value is selected from said set of scalar quantization values as an approximation to said second data value.

8. The encoder of claim 5 wherein said first and second quantization processes each comprise an adaptive differential pulse code modulation scheme which selects said corresponding quantized data values from a single predetermined set of scalar quantization values, and wherein said second quantized data value is determined such that said first quantization error and said second quantization error are scalar arithmetic values having opposite sign.

9. The encoder of claim 5 wherein said first and second coding algorithms each comprise a code excited linear predictive coding scheme, wherein said first and second quantization processes select said corresponding quantized data values from a single predetermined set of excitation vectors, and wherein said second quantization process selects a different excitation vector than said first quantization process.

10. The encoder of claim 1 further comprising means for modifying said first and second quantization processes in a periodic fashion, such that after a first predetermined amount of time,

(i) said first quantization process produces a subsequent first quantized data value based at least in part on a corresponding subsequent second quantization error resulting from said second quantization process, and

(ii) said second quantization process produces a subsequent second quantized data value not based on a corresponding subsequent first quantization error resulting from said first quantization process; and

after a second predetermined amount of time,

(iii) said second quantization process produces a further subsequent second quantized data value based at least in part on a corresponding further subsequent first quantization error resulting from said first quantization process, and

(iv) said first quantization process produces a further subsequent first quantized data value not based on a corresponding further subsequent second quantization error resulting from said second quantization process.

11. The encoder of claim 10 wherein said first predetermined amount of time and said second predetermined amount of time are equal.

12. The encoder of claim 10 wherein said first and second predetermined amounts of time are based on quality levels associated with a first communications channel used for transmitting said first multi-descriptive bit stream and a second communications channel used for transmitting said second multi-descriptive bit stream, respectively.

13. The encoder of claim 12 wherein a ratio of said first predetermined amount of time divided by said second predetermined amount of time is approximately equal to a ratio of an estimated probability of a frame erasure occurring in a transmission across said second communications channel divided by an estimated probability of a frame erasure occurring in a transmission across said first communications channel.

14. A multi-descriptive encoder for generating a plurality of multi-descriptive bit streams from a single source signal, the encoder comprising:

a source signal input port;

a first coder applied to the source signal input port, the first coder for generating a first multi-descriptive bit stream from the source signal; and

a second coder applied to the source signal input port, the second coder for generating a second multi-descriptive bit stream from the source signal,

wherein said first multi-descriptive bit stream and said second multi-descriptive bit stream differ, and wherein each bit stream is decodable by an identical decoding algorithm to generate a corresponding different reconstruction of said source signal.

15. The encoder of claim 14 wherein said first coder employs a first coding algorithm including a first quantization process and said second coder employs a second coding algorithm including a second quantization process, and wherein the first and second coding algorithms differ in at most the corresponding quantization processes included therein.

16. The encoder of claim 14 wherein said first quantization process and said second quantization process each select corresponding quantized data values from a single predetermined set of quantization values.

17. The encoder of claim 16 wherein said first quantization process and said second quantization process each comprise a pulse code modulation scheme which selects said corresponding quantized data values from a single predetermined set of scalar quantization values.

18. The encoder of claim 16 wherein said first quantization process and said second quantization process each comprise an adaptive differential pulse code modulation scheme which selects said corresponding quantized data values from a single predetermined set of scalar quantization values.

19. The encoder of claim 16 wherein said first and second coding algorithms each comprise a code excited linear predictive coding scheme and wherein said first and second quantization processes select said corresponding quantized data values from a single predetermined set of excitation vectors.

20. The encoder of claim 14 wherein said source signal comprises a speech signal.

21. A multi-descriptive decoder system for decoding a plurality of multi-descriptive bit streams each comprising a representation of a single source signal and for producing a single reconstructed source signal therefrom, the decoder system comprising:

a plurality of decoders corresponding to the plurality of multi-descriptive bit streams to be decoded, each of said decoders generating a corresponding decoded bit stream; and

a mixer for combining said decoded bit streams to produce the reconstructed source signal,

wherein the plurality of multi-descriptive bit streams have been generated by a multi-descriptive encoder which comprises,

(i) a source signal input port for supplying a single source signal,

(ii) a first coder applied to the source signal input port, the first coder for generating a first multi-descriptive bit stream from the source signal, the first coder employing a first coding algorithm which includes a first quantization process in which a first data value based on the source signal is coded with use of a corresponding first quantized data value, thereby resulting in a corresponding first quantization error representative of a difference between said first data value and said first quantized data value, and

(iii) a second coder applied to the source signal input port, the second coder for generating a second multi-descriptive bit stream from the source signal, the second coder employing a second coding algorithm which includes a second quantization process in which a second data value, based on the source signal and corresponding to said first data value, is coded with use of a corresponding second quantized data value, thereby resulting in a corresponding second quantization error representative of a difference between said second data value and said second quantized data value,

and wherein said second quantized data value as produced by said second quantization process is based at least in part on said first quantization error resulting from said first quantization process.

22. The decoder system of claim 21 wherein said source signal comprises a speech signal.

23. The decoder system of claim 21 wherein said each of said multi-descriptive bit streams have been encoded with use of a pulse code modulation scheme.

24. The decoder system of claim 21 wherein said each of said multi-descriptive bit streams have been encoded with use of an adaptive differential pulse code modulation scheme.

25. The decoder system of claim 21 wherein said each of said multi-descriptive bit streams have been encoded with use of a code excited linear predictive coding scheme.

26. The decoder system of claim 21 wherein each of said plurality of decoders has a corresponding internal state thereof, and wherein said internal state corresponding to a first one of said plurality of decoders is updated based on said internal state corresponding to another one of said plurality of decoders when said multi-descriptive bit stream corresponding to said first one of said plurality of decoders experiences a frame erasure.

27. A multi-descriptive decoder system for decoding a plurality of distinct multi-descriptive bit streams each comprising a different representation of a single source signal and for producing a single reconstructed source signal therefrom, the decoder system comprising:

a plurality of decoders corresponding to the plurality of multi-descriptive bit streams to be decoded, each of said decoders generating a corresponding plurality of decoded bit streams, each of said plurality of decoders employing an identical decoding algorithm; and

a mixer for combining said plurality of decoded bit streams to produce the reconstructed source signal.

28. The decoder system of claim 27 wherein said source signal comprises a speech signal.

29. The decoder system of claim 27 wherein said each of said multi-descriptive bit streams have been encoded with use of a pulse code modulation scheme.

30. The decoder system of claim 27 wherein said each of said multi-descriptive bit streams have been encoded with use of an adaptive differential pulse code modulation scheme.

31. The decoder system of claim 27 wherein said each of said multi-descriptive bit streams have been encoded with use of a code excited linear predictive coding scheme.

32. The decoder system of claim 27 wherein each of said plurality of decoders has a corresponding internal state thereof, and wherein said internal state corresponding to a first one of said plurality of decoders is updated based on said internal state corresponding to another one of said plurality of decoders when said multi-descriptive bit stream corresponding to said first one of said plurality of decoders experiences a frame erasure.

33. A method for performing multi-descriptive encoding of a single source signal and for generating a plurality of multi-descriptive bit streams therefrom, the method comprising the steps of:

coding the source signal with a first coder to generate a first multi-descriptive bit stream, the first coder employing a first coding algorithm which includes a first quantization process in which a first data value based on the source signal is coded with use of a corresponding first quantized data value, thereby resulting in a corresponding first quantization error representative of a difference between said first data value and said first quantized data value; and

coding the source signal with a second coder to generate a second multi-descriptive bit stream, the second coder employing a second coding algorithm which includes a second quantization process in which a second data value, based on the source signal and corresponding to said first data value, is coded with use of a corresponding second quantized data value, thereby resulting in a corresponding second quantization error representative of a difference between said second data value and said second quantized data value,

wherein said second quantized data value as produced by said second quantization process is based at least in part on said first quantization error resulting from said first quantization process.

34. The method of claim 33 wherein said first coding algorithm and said second coding algorithm differ in at most the corresponding quantization processes included therein.

35. The method of claim 33 wherein said source signal comprises a speech signal.

36. The method of claim 33 wherein said second quantized data value as produced by said second quantization process is determined so that said second quantization error resulting from said second quantization process is such that if combined with said first quantization error resulting from said first quantization process to produce a net quantization error, said net quantization error will be less than said first quantization error.

37. The method of claim 33 wherein said first quantization process and said second quantization process each select said corresponding quantized data values from a single predetermined set of quantization values.

38. The method of claim 37 wherein said first and second quantization processes each comprise a pulse code modulation scheme which selects said corresponding quantized data values from a single predetermined set of scalar quantization values, wherein said first data value based on the source signal and said second data value based on the source signal are equal to a common scalar value representative of a portion of said source signal, wherein said first quantized data value is selected from said set of scalar quantization values as an approximation to said common scalar value, and wherein said second quantized data value is selected as a neighboring value in said set of quantization values to said first quantized data value when said common scalar value is closer to an average of said first quantized data value and said neighboring value than to any value in said set of quantization values.

39. The method of claim 37 wherein said first and second quantization processes each comprise a pulse code modulation scheme which selects said corresponding quantized data values from a single predetermined set of scalar quantization values, wherein said first data value based on the source signal is equal to a scalar value representative of a portion of said source signal and said second data value based on the

source signal is equal to said first data value offset by a fixed predetermined amount, and wherein said first quantized data value is selected from said set of scalar quantization values as an approximation to said first data value and said second quantized data value is selected from said set of scalar quantization values as an approximation to said second data value.

40. The method of claim 37 wherein said first and second quantization processes each comprise an adaptive differential pulse code modulation scheme which selects said corresponding quantized data values from a single predetermined set of scalar quantization values, and wherein said second quantized data value is determined such that said first quantization error and said second quantization error are scalar arithmetic values having opposite sign.

41. The method of claim 37 wherein said first and second coding algorithms each comprise a code excited linear predictive coding scheme, wherein said first and second quantization processes select said corresponding quantized data values from a single predetermined set of excitation vectors, and wherein said second quantization process selects a different excitation vector than said first quantization process.

42. The method of claim 33 further comprising the step of modifying said first and second quantization processes in a periodic fashion, such that after a first predetermined amount of time,

(i) said first quantization process produces a subsequent first quantized data value based at least in part on a corresponding subsequent second quantization error resulting from said second quantization process, and

(ii) said second quantization process produces a subsequent second quantized data value not based on a corresponding subsequent first quantization error resulting from said first quantization process; and

after a second predetermined amount of time,

(iii) said second quantization process produces a further subsequent second quantized data value based at least in part on a corresponding further subsequent first quantization error resulting from said first quantization process, and

(iv) said first quantization process produces a further subsequent first quantized data value not based on a corresponding further subsequent second quantization error resulting from said second quantization process.

43. The method of claim 42 wherein said first predetermined amount of time and said second predetermined amount of time are equal.

44. The method of claim 42 wherein said first and second predetermined amounts of time are based on quality levels associated with a first communications channel used for transmitting said first multi-descriptive bit stream and a second communications channel used for transmitting said second multi-descriptive bit stream, respectively.

45. The method of claim 44 wherein a ratio of said first predetermined amount of time divided by said second predetermined amount of time is approximately equal to a ratio of an estimated probability of a frame erasure occurring in a transmission across said second communications channel divided by an estimated probability of a frame erasure occurring in a transmission across said first communications channel.

46. A method for performing multi-descriptive encoding of a single source signal and for generating a plurality of multi-descriptive bit streams therefrom, the method comprising the steps of:

coding the source signal with a first coder to generate a first multi-descriptive bit stream therefrom; and

coding the source signal with a second coder to generate a second multi-descriptive bit stream therefrom,

wherein said first multi-descriptive bit stream and said second multi-descriptive bit stream differ, and wherein each bit stream is decodable by an identical decoding algorithm to generate a corresponding different reconstruction of said source signal.

47. The method of claim 46 wherein said first coder employs a first coding algorithm including a first quantization process and said second coder employs a second coding algorithm including a second quantization process, and wherein the first and second coding algorithms differ in at most the corresponding quantization processes included therein.

48. The method of claim 46 wherein said first quantization process and said second quantization process each select corresponding quantized data values from a single predetermined set of quantization values.

49. The method of claim 48 wherein said first quantization process and said second quantization process each comprise a pulse code modulation scheme which selects said corresponding quantized data values from a single predetermined set of scalar quantization values.

50. The method of claim 48 wherein said first quantization process and said second quantization process each comprise an adaptive differential pulse code modulation scheme which selects said corresponding quantized data values from a single predetermined set of scalar quantization values.

51. The method of claim 48 wherein said first and second coding algorithms each comprise a code excited linear predictive coding scheme and wherein said first and second quantization processes select said corresponding quantized data values from a single predetermined set of excitation vectors.

52. The method of claim 46 wherein said source signal comprises a speech signal.

53. A method of decoding a plurality of multi-descriptive bit streams each comprising a representation of a single common source signal and producing a single reconstructed source signal therefrom, the method comprising the steps of:

decoding the plurality of multi-descriptive bit streams with a corresponding plurality of decoders to generate a corresponding plurality of decoded bit streams; and

combining said decoded bit streams to produce the reconstructed source signal,

wherein the plurality of multi-descriptive bit streams have been generated by a method for multi-descriptive encoding which comprises the steps of,

(i) coding the source signal with a first coder to generate a first multi-descriptive bit stream, the first coder employing a first coding algorithm which includes a first quantization process in which a first data value based on the source signal is coded with use of a corresponding first quantized data value, thereby resulting in a corresponding first quantization error representative of a difference between said first data value and said first quantized data value, and

(ii) coding the source signal with a second coder to generate a second multi-descriptive bit stream, the second coder employing a second coding algorithm which includes a second quantization process in which a second data value, based on the source signal and corresponding to said first data value, is coded with use of a corresponding second quantized data value, thereby resulting in a corresponding second quantization error representative of a difference between said second data value and said second quantized data value,

and wherein said second quantized data value as produced by said second quantization process is based at least in part on said first quantization error resulting from said first quantization process.

54. The method of claim 53 wherein said source signal comprises a speech signal.

55. The method of claim 53 wherein said each of said multi-descriptive bit streams have been encoded with use of a pulse code modulation scheme.

56. The method of claim 53 wherein said each of said multi-descriptive bit streams have been encoded with use of an adaptive differential pulse code modulation scheme.

57. The method of claim 53 wherein said each of said multi-descriptive bit streams have been encoded with use of a code excited linear predictive coding scheme.

58. The method of claim 53 wherein each of said plurality of decoders has a corresponding internal state thereof, and wherein said method further comprises the step of updating said internal state corresponding to a first one of said plurality of decoders based on said internal state corresponding to another one of said plurality of decoders when said multi-descriptive bit stream corresponding to said first one of said plurality of decoders experiences a frame erasure.

59. A method of decoding a plurality of distinct multi-descriptive bit streams each comprising a different representation of a single common source signal and producing a single reconstructed source signal therefrom, the method comprising the steps of:

decoding said plurality of multi-descriptive bit streams with a corresponding plurality of decoders to generate a corresponding plurality of decoded bit streams, each of said plurality of decoders employing an identical decoding algorithm; and

combining said plurality of decoded bit streams to produce the reconstructed source signal.

60. The method of claim 59 wherein said source signal comprises a speech signal.

61. The method of claim 59 wherein said each of said multi-descriptive bit streams have been encoded with use of a pulse code modulation scheme.

62. The method of claim 59 wherein said each of said multi-descriptive bit streams have been encoded with use of an adaptive differential pulse code modulation scheme.

63. The method of claim 59 wherein said each of said multi-descriptive bit streams have been encoded with use of a code excited linear predictive coding scheme.

64. The method of claim 59 wherein each of said plurality of decoders has a corresponding internal state thereof, and wherein said method further comprises the step of updating said internal state corresponding to a first one of said plurality of decoders based on said internal state corresponding to another one of said plurality of decoders when said multi-descriptive bit stream corresponding to said first one of said plurality of decoders experiences a frame erasure.